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ABSTRACT

Reported is a field test of the basic numerical skills workbook developed for Navy personnel. Two groups of subjects were used at the Recruit Training Command, Orlando, Florida, during early 1980. The design of the workbook, entitled "Improving Your Navy Numerical Skills," was directed toward meeting the needs of personnel who have difficulty with elementary mathematics. Data utilized in the field test were provided by four instruments: (1) the Armed Services Vocational Aptitude Battery, (2) the Gates-MacGinitie Reading Test (comprehension), (3) the Test of Adult Basic Education (mathematics), and (4) the Navy Numerical Skills Test. The first three tests are standardized instruments, while the last was developed specifically for the workbook. The results of the study indicate that the workbook can be used beneficially with Navy enlisted personnel who need to improve their basic numerical skills. It is suggested that students with relatively low academic skills can improve their performance by using this tool. The strategy and format used in preparing the workbook is seen as potentially useful in developing learning aids for technical training that requires more advanced quantitative skills. (MP)

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TECHNICAL NOTE 8-80

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NUMERICAL SKILLS OF NAVY STUDENTS: AN EVALUATION OF A SKILL DEVELOPMENT WORKBOOK

DECEMBER 1980

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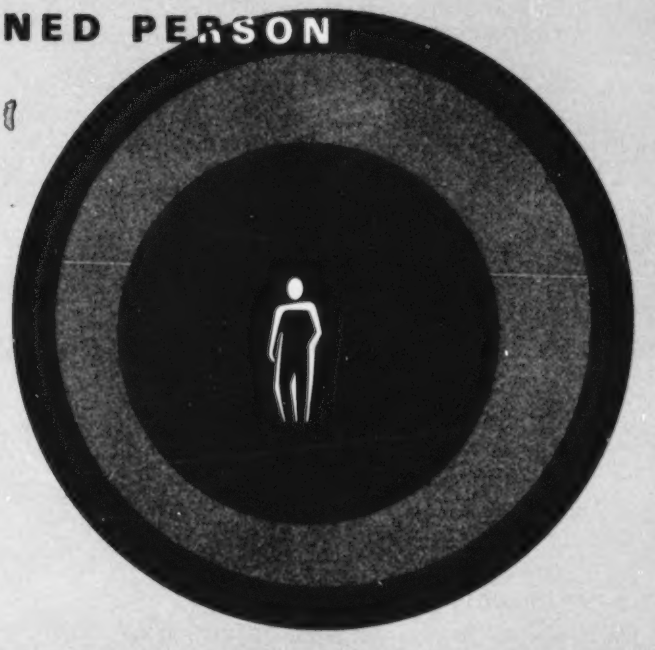

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NUMERICAL SKILLS OF NAVY STUDENTS: AN EVALUATION OF A SKILL DEVELOPMENT WORKBOOK

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SECTION I

INTRODUCTION

In recent years, basic skills training for enlisted Navy personnel has become an increasing necessity. Reading, verbal language, and mathematics instruction have been addressed in various programs designed for recruits, general detail sailors, and technical training qualified personnel. The current emphasis on basic skills training is expected to continue into the foreseeable future.

During the summer of 1979, a team of research and development specialists from Memphis State University and the Department of the Navy initiated an effort to prepare a basic numerical skills workbook for use with Navy personnel. Staff members from the Training Analysis and Evaluation Group in Orlando, Florida, identified potential topics to utilize in developing lessons involving applications of numerical skills. Review and recommendations concerning the topics were provided by personnel from the Naval Technical Training Command in Millington, Tennessee. Members of the project team from Memphis State University were responsible for developing the materials that were incorporated into the workbook.

The purpose of this paper is to report on a field test of the numerical skills workbook that was conducted with enlisted Navy personnel at the Recruit Training Command in Orlando, Florida. Information will be provided on the subjects, data sources, implementation procedures, and results. Background information will be presented in a description of the developmental activities.

SECTION II

DEVELOPMENTAL ACTIVITIES

The requirement of quantitative skills is apparent in many types of Navy training for jobs that involve applications of modern technology. While the need for basic numerical skills among general detail personnel is less obvious, the use of quantitative skills is necessary in many daily functions. The design of the workbook entitled Improving Your Navy Numerical Skills[1] was directed toward meeting the needs of personnel who have difficulty with elementary mathematics.

The specifications for the workbook covered three areas as reflected by the workbook sections: Basic Numerical Skills, Numerical Skills in the Navy, and Numerical Skills in Personal Finances. The first section provides exercises on the basic operations of addition, subtraction, multiplication, and division. The second focuses on the application of numerical skills in Navy-relevant situations. The final section deals with the application of numerical skills to financial responsibilities of the individual in the Navy and civilian life.

The three sections of the workbook are organized on the basis of topics with one or more lessons on each topic. The introduction to each topic deals with the significance, concept, and/or formulas related to the topic. The lessons that follow the discussion include learner objectives and application exercises as well as review exercises where appropriate. The answers to the exercises are reported in the back of the workbook.

Two forms of a 50-item numerical skills test were developed for use with the workbook. The content of each test is correlated with the topics and related exercises contained in the workbook. The first 24 items on the instrument can be used to identify students who should be assigned the first section of the workbook on basic numerical skills. The total scores from the pretest and posttest with the two forms provide an assessment of student progress as a result of using the workbook.

FIELD TEST

The field test of the numerical skills workbook was conducted with two groups of Navy personnel at the Recruit Training Command, Orlando, during the early part of 1980. One group of subjects consisted of 25 students (5 females and 20 males) who had been assigned to Apprentice Training. These students were not qualified for technical training and were assigned to training for general detail assignments. The second group of subjects was comprised of 25 students (13 females and 12 males) who were assigned to Academic Remedial Training. They were recruits who had been diagnosed as having reading deficiencies that would prevent or delay completion of recruit training (generally defined as 6.0 reading grade level or below).

[1] Bowman, H. L., Jones, P. L., Kaiser, R. A., Kincaid, J. P., McDaniel, W. C., and Salas, E. Improving Your Navy Numerical Skills. 1980. Prepared by Memphis State University, Memphis, TN 38152 and Training Analysis and Evaluation Group, Orlando, FL 32813.

Data utilized in the field test were provided by four instruments: the Armed Services Vocational Aptitude Battery, the Gates-MacGinitie Reading Test (comprehension), the Test of Adult Basic Education (mathematics), and the Navy Numerical Skills Test. The first three tests are standardized instruments while the last was developed specifically for the numerical skills workbook. Data on the age of the subjects were obtained from available records on the students.

The Armed Services Vocational Aptitude Battery (ASVAB) is a standardized instrument that measures aptitude using 12 subtests. The test is administered to all personnel who enter the military services prior to their enlistment. Raw scores are converted to percentile ranks for interpretation. The scores from the subtests on arithmetic reasoning and word knowledge were utilized in the study. These data were obtained from the records of the subjects.

The Gates-MacGinitie Reading Test is a standardized instrument that measures vocabulary and comprehension. The comprehension part of Level D for fifth and sixth grade reading levels is administered to all Navy recruits during their first week in boot camp. Raw scores are transformed to reading grade levels using the norm tables. The records of the subjects provided their reading grade level scores on comprehension as measured by the Gates.

The Test of Adult Basic Education (TABE) is a normed instrument with four sections on mathematics that assess performance on computation and concepts/problem solving. Grade equivalent scores are obtained by conversion of the raw scores using the norm tables. Level M of the TABE for the fourth through sixth grade range was administered to all subjects involved in the field test to provide descriptive data before the workbook was implemented.

The Navy Numerical Skills Test is an instrument that measures performance on the numerical skills addressed in the workbook. Items 1-24 measure basic numerical operations while items 25-50 assess proficiency in applying the skills to the topics covered in the workbook. The instrument was used with the subjects of the two groups as pretests and posttests. Form A was administered as the pretest for the subjects in Academic Remedial Training while Form B was used for this purpose with the subjects in Apprentice Training. The alternate form was used as the posttest with each group. The raw scores were utilized in the analyses of the data for the two groups.

The reliability of the two forms of the Navy Numerical Skills Test was determined initially by administration of each form to independent groups of Navy recruits. The two groups were compared with respect to reading grade level, arithmetic reasoning, and word knowledge. (See table 1.) The means on these variables were not significantly different for the two groups. The means of the two groups on the Navy Numerical Skills Test did not differ significantly for the two parts or total test. (See table 2.) The reliability estimates for the two forms were computed using the Kuder-Richardson (K-R) Formula 20 and the Spearman-Brown correlation. (See table 3.) Based on the data from the groups of recruits and the two field test groups, the reliability estimates for Form A ranged from .75 to .86 on the K-R 20 and .78 to .86 on the Spearman-Brown. The reliabilities for Form B varied from .80 to .82 on the K-R 20 and .79 to .87 on the Spearman-Brown. The results of these analyses

TABLE 1. SUMMARY OF DATA AND ANALYSES FOR SCORES OF RECRUITS ON DESCRIPTIVE VARIABLES

Variable	Group		
	I (N=63)	II (N=64)	t*
Reading Grade Level			
Mean	10.26	10.21	.08
S.D.	2.16	2.46	
Arithmetic Reasoning			
Mean	52.57	52.11	.21
S.D.	7.99	7.37	
Word Knowledge			
Mean	54.78	54.50	.15
S.D.	5.88	7.27	

*t = ± 2.01, df = 48, level of significance = .05

TABLE 2. SUMMARY OF DATA AND ANALYSES FOR SCORES OF RECRUITS ON THE NUMERICAL SKILLS TEST

Variable	Test Form		
	I (N=63)	II (N=64)	t*
Part I			
Mean	22.94	22.75	.72
S.D.	1.39	1.53	
Part II			
Mean	17.48	16.28	.99
S.D.	3.99	4.59	
Total			
Mean	40.42	39.03	.94
S.D.	4.56	5.68	

*t = ± 2.01, df = 48, level of significance = .05

TABLE 3. RELIABILITY ESTIMATES FOR THE NUMERICAL SKILLS TEST

Subjects	N	Test Form	
		A	B
Recruits			
Group I	63		
K-R 20		.75	---
S-B		.78	---
Group II	64		
K-R 20		---	.82
S-B		---	.85
Apprentice Training Students	25		
K-R 20		.86	.82
S-B		.86	.79
Academic Remedial Training Students	25		
K-R 20		.80	.80
S-B		.84	.87

Note: K-R 20 = Kuder-Richardson Formula 20 correlation
S-B = Spearman-Brown correlation

indicate that the two forms of the Navy Numerical Skills Test had sufficient reliability and could be regarded as equivalent forms.

WORKBOOK IMPLEMENTATION

The field test of the workbook with the subjects in Apprentice Training was completed within 1 week. The students were selected and tested with the TABE and the Navy Numerical Skills Test - Form B - at the beginning of the week. The workbook was utilized as assigned work for 20 hours of supervised study in the classroom during the remainder of the week. All sections of the workbook were assigned to the students. The instructor was available to answer questions about the lessons. Form A of the Navy Numerical Skills Test was administered at the end of the week.

The subjects in Academic Remedial Training participated in the workbook field test over a period of 1 month. The TABE and the Navy Numerical Skills Test - Form A - were administered to the subjects at the beginning of the period. Approximately 1 hour per day was devoted to work on the exercises in the three sections of the workbook. The students spent about 20 hours on these activities. They worked under the supervision of an instructor who could answer their questions about the lessons. Form B of the Navy Numerical Skills Test was utilized as a posttest at the end of the month.

DATA ANALYSES

The descriptive data that were collected on the Apprentice Training subjects and the Academic Remedial Training subjects who participated in the field test are summarized and compared in table 4. The mean ages of the two groups were approximately 19 years old and did not differ significantly at the .05 level. The mean percentile ranks on arithmetic reasoning as measured by the ASVAB scores for the two groups did not differ significantly although the mean was slightly higher for the Apprentice Training subjects. The Apprentice Training subjects had significantly higher means for percentile ranks on word knowledge as measured by the ASVAB and reading grade level on comprehension as measured by the Gates. These differences were expected since the Academic Remedial Training subjects had been previously diagnosed as having reading deficiencies. Results from the TABE showed that the two groups did not differ significantly on mean grade equivalents for computation and total but differed significantly on concepts/problem solving. The comparisons of the two groups on the TABE produced predictable results because Apprentice Training students are generally higher achievers than Academic Remedial Training students.

The data and analyses for the scores of the Apprentice Training subjects on the Navy Numerical Skills Test are summarized in table 5. The means of the 24 items in part I on basic numerical skills indicated that most of the items were answered correctly on both the pretest and the posttest. A review of the means for the 26 items in part II on applied numerical skills revealed that almost half of the responses were correct on the pretest while almost two-thirds of the responses were correct on the posttest. Of course, the means for the total score reflected the composite for the two parts of the test.

TABLE 4. SUMMARY OF DATA AND ANALYSES FOR SCORES OF APPRENTICE TRAINING AND ACADEMIC REMEDIAL TRAINING STUDENTS ON DESCRIPTIVE VARIABLES

Variable	Group		
	Apprentice	Academic Remedial Training	t*
Age			
N	25	25	
Mean	19.48	19.08	.90
S.D.	1.81	1.29	
Arithmetic Reasoning (ASVAB)			
N	25	21	
Mean	44.44	43.00	.93
S.D.	4.58	5.72	
Word Knowledge (ASVAB)			
N	25	22	
Mean	50.44	43.59	3.60
S.D.	6.73	6.29	
Reading Grade Level (Gates)			
N	25	25	
Mean	8.63	4.79	7.38
S.D.	2.25	1.31	
TABE - Computation			
N	25	25	
Mean	7.16	7.08	.20
S.D.	1.38	1.42	
TABE - Concepts/Problem Solving			
N	25	25	
Mean	7.98	6.72	3.21
S.D.	1.18	1.57	
TABE - Total			
N	25	25	
Mean	7.51	6.95	1.52
S.D.	1.27	1.33	

*t = $\pm$ 2.01; df - 44, 45, or 48; level of significance = .05

TABLE 5. SUMMARY OF DATA AND ANALYSES FOR SCORES OF APPRENTICE TRAINING SUBJECTS ON THE NAVY NUMERICAL SKILLS TEST (N=25)

	Mean	S.D.	t*
		Pretest - Form B	
Part I	22.28	2.84	---
Part II	12.96	4.20	---
Total	35.24	5.80	---
		Posttest - Form A	
Part I	23.08	1.87	---
Part II	16.68	4.49	---
Total	39.76	5.75	---
		Change	
Part I	.80	1.53	2.62
Part II	3.72	3.43	5.42
Total	4.52	3.38	6.69

*$t = \pm 2.06$, df = 24, level of significance = .05

$H_o: \mu = 0$

The change scores of the Apprentice Training subjects were computed for the two parts and total on the Navy Numerical Skills Test by subtracting the pretest scores from the posttest scores. The change score means were compared with hypothesized changes of 0 using the t test for one group. Although the change score mean for part I was only .80, it was significant at the .05 level. The change of 3.72 on part II was also statistically significant. Since the change for the total score is the composite of the two parts, the total change score mean was statistically significant as expected.

The summary of the data and analyses for the scores of the Academic Remedial Training subjects on the Navy Numerical Skills Test is reported in table 6. In reference to the 24 items in part I of the test, the means showed that the subjects performed very well on the pretest (21.80) and the posttest (23.08). With respect to the 26 items in part II, the means indicated that about two-fifths of the responses were correct on the pretest and slightly more than half were correct on the posttest. The means for the total score reflected a similar pattern on the pretest and the posttest.

The pretest scores were subtracted from the posttest scores to obtain the change scores of the Academic Remedial Training subjects on the two parts and total for the test. The t test for one group was used to compare the obtained change score means with hypothesized means of 0. The change score mean of 1.28 for part I represented a significant change at the .05 level from the pretest to the posttest. On part II of the test, the change score mean of 3.36 was statistically significant. As expected, based on the results for the two part scores, the mean for the total score change was also statistically significant.

CONCLUSIONS AND RECOMMENDATIONS

The efforts of the research and development team were successful in producing a basic numerical skills workbook that is effective with Navy enlisted personnel who are relatively low achievers academically. The procedures used in developing the workbook and the related test assured that the content was relevant to students in the Navy. The reliability of each test form was found to be quite satisfactory.

The field test of the workbook on Improving Your Navy Numerical Skills suggests that students with relatively low academic skills can improve their performance on numerical skills by using the workbook. The pretest with the Navy Numerical Skills Test revealed that most students performed very well on basic numerical operations. Consequently, slight improvements that were, nonetheless, statistically significant were obtained in this area. Considerably more improvement was observed in the area of applying numerical skills to situations in the Navy and personal finances. Significant changes were observed in this area of performance.

The results of the field test indicate that the workbook can be used beneficially with Navy enlisted personnel who need to improve their basic numerical skills. Consideration should be given specifically to its use with students in Apprentice Training and Academic Remedial Training. Use of the

TABLE 6. SUMMARY OF DATA AND ANALYSES FOR SCORES OF ACADEMIC REMEDIAL TRAINING SUBJECTS ON THE NAVY NUMERICAL SKILLS TEST (N=25)

	Mean	S.D.	t*
		Pretest - Form A	
Part I	21.80	3.10	---
Part II	10.08	3.75	---
Total	31.88	5.66	---
		Posttest - Form A	
Part I	23.08	1.93	---
Part II	13.44	4.40	---
Total	36.52	5.51	---
		Change	
Part I	1.28	2.82	2.26
Part II	3.36	3.04	5.52
Total	4.64	3.19	7.27

*$t = \pm 2.06$, df = 24, level of significance = .05

H_o: $\mu = 0$

workbook might be appropriate with students who experience difficulty with quantitative operations in technical training requiring basic numerical skills. The strategy and format used in preparing the workbook may also be useful in developing learning aids for technical training that requires more advanced quantitative skills.

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